Author: Pennsylvania State College

Title: School leaflet, no. 1-10

Place of Publication: State College, Pa.

Copyright Date: 1917?

Master Negative Storage Number: MNS# PSt SNPaAg029.16

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110 2 Pennsylvania State College $bDept. of Agricultural Education
245 00 School leaflet $cPennsylvania State College, School of Agriculture and Experiment Station, Department of Agricultural Education
260 [State College, Pa. $bThe Dept. $c1917?]
300 v. $bill. $c24 cm.
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Number 1

THE PENNSYLVANIA STATE COLLEGE
SCHOOL OF AGRICULTURE
AND EXPERIMENT STATION

The Pennsylvania State College

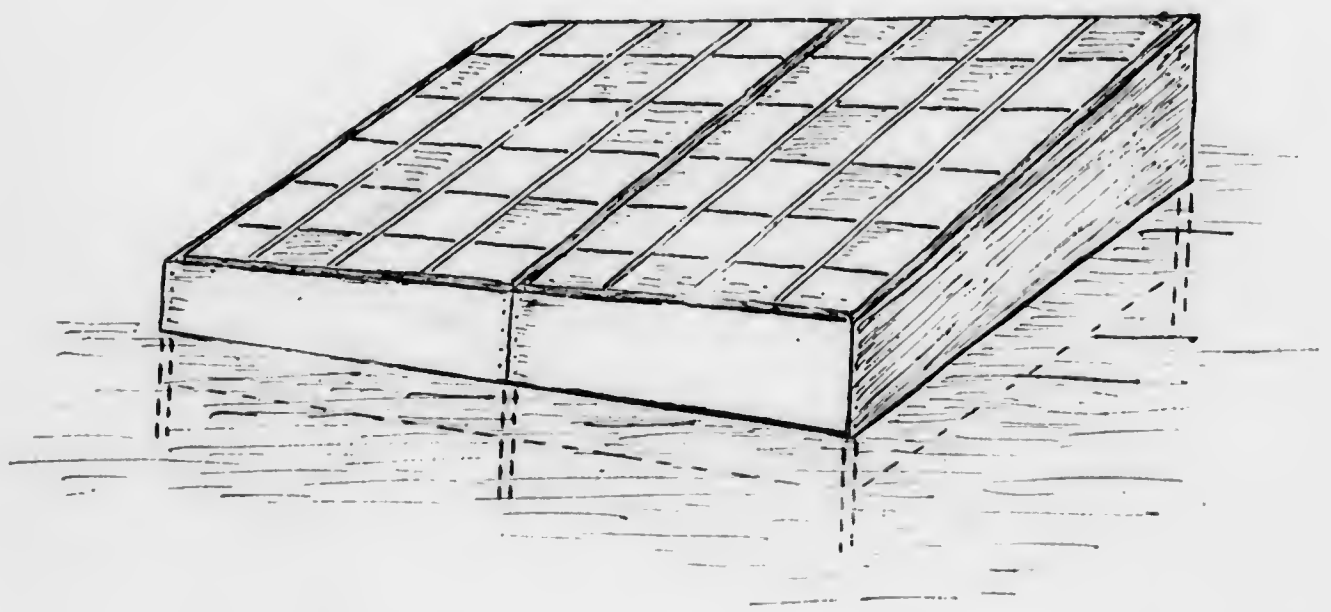
School of Agriculture *and* Experiment Station

Department of Agricultural Education

School Leaflet No. 1

HOW TO MAKE A HOTBED

By J. S. GARDNER



A hotbed is usually heated by warmth from fermenting manure, instead of by steam or hot water. The principal use for a hotbed is the starting of early plants for transplanting, though sometimes crops of radishes and lettuce are raised, in this way, out of their normal season.

Location

The hotbed should be placed where it can be visited often. The care which it needs is simple, but it must be regular. For this reason, it should not be too far from the house. It may be placed near a path

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along which there is frequent travel—the path between the house and barn, for instance.

Since hotbed crops must be watered by hand, a water supply close by will save the labor of carrying water.

The hotbed should be set on the southern or southeastern side of some building, fence or woodland, to shelter it from cold winds. If, in addition, it can be set on a slight slope to the south or east, the sun will strike it more directly and evenly and the bed will hold its heat much better.

The Pit

The pit should be dug to fit the sash, which are usually 3 x 6 feet in size. The pit then should be 6 feet wide with a length which is some multiple of 3 feet, and should run east and west. It should be 2 or more feet deep according to climate. If there is danger of surface water running into it, a ditch will lead this water away. A layer of cinders or stone in the bottom of the pit or a line of tile will drain away any water that may get into the pit, in spite of precautions.

The Frame

The frame can be made of odds and ends of lumber, though, of course, new lumber will make a better-looking bed. Posts 2″ x 4″ are set in the corners and at intervals of 3 feet along each side. To the posts are nailed the side and end boards of one inch undressed hemlock or other inexpensive wood. If the soil is gravelly and likely to cave in, these side boards should extend to the bottom of the pit. If the soil is a stiff clay, the pit will not need such lining, though, if the bed is to be a permanent one, the lining would better be put in.

The side boards are made 8 inches high on the south and 14 inches on the north; the ends are sloped according to these heights. Cross pieces 2″ x 4″ are fastened between the tops of the posts. The edges of the sash rest on these cross pieces.

The Sash

Sash for this purpose can be bought of seedsmen, either glazed or unglazed. There are two thicknesses, $1\frac{3}{8}$″ and $1\frac{3}{4}$″, and a variety of sizes, but 3 x 6 feet is most used.

Glass comes separately, 50 square feet in a box. The glazing is done at home, or local hardware men or planing mills may furnish the sash glazed and painted, at reasonable prices.

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The Manure

The manure must be fresh horse manure, containing not more than one-third bedding. Too much bedding causes a slow heating, and the heat is soon spent.

The preparation of the manure should begin a week or ten days before it is to be used. It should be stacked in a compact mass, and if rather dry, some hot water applied to hasten fermentation. In a few days the pile should be turned inside out, to get the outside parts to heating. Repiling again will be an advantage, and may be necessary; that will depend on how well steaming has begun.

Filling the Pit

The pit is filled in layers of about 6 inches, up to within 4 inches of the outside ground line. In the northern part of the state, as much as 30 inches of manure is needed in severe weather. In the southern counties of the state, and in a mild season, the quantity of manure can be reduced to 15 inches. Each layer is tramped so that there will be no open spaces.

On top of the manure, a layer of 4 inches of rich garden soil is placed, and then the hotbed is ready for the sash. For a day or so it will heat violently, but when the temperature has fallen to 90 degrees Fahrenheit, the seeds may be sown.

Planting Seeds

What seeds to plant will depend on the gardener. If the bed is ready March 1, cabbage, lettuce and cauliflower for transplanting may be sown. Their planting depth should be $\frac{1}{4}$ inch; the seeds 10 to an inch in furrows 2 inches apart.

If a crop of mature radishes is desired, the seed is dropped in furrows $\frac{1}{4}$ inch deep and 3 inches apart, three seeds per inch.

Care of the Hotbed

After seed sowing, a thorough watering should be given, and the sash replaced.

If the noons are sunny and there is "sweat" on the glass, the edge of the sash away from wind should be slightly raised for a short time, particularly if the thermometer stands well above 60 degrees. It is

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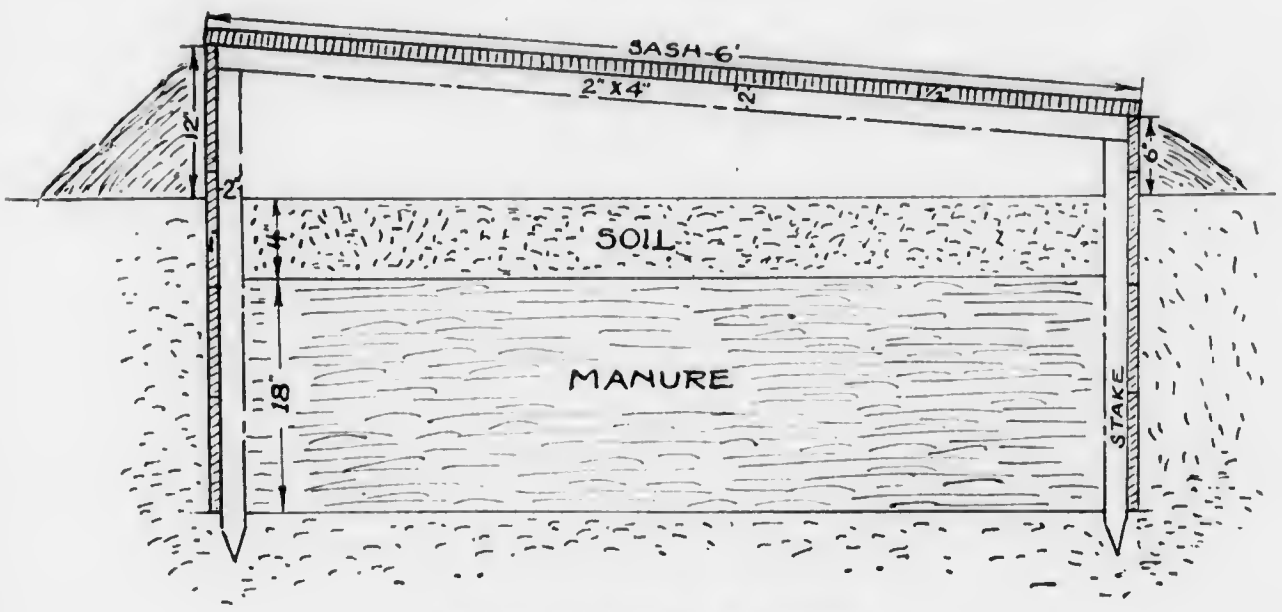
well to have a thermometer in the bed always. As the season advances the sash may be gradually raised for longer intervals.

The first watering, if properly done, will likely suffice until the seed comes up. If not, water should be applied whenever the soil below the top half-inch begins to get dry.

Watering should be thorough, but not too frequent; on sunny days water should be applied early in the day.

Neglect of ventilation and watering may invite seedling diseases, notably "damping off".



Cross-section of hotbed

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Number 2

THE PENNSYLVANIA STATE COLLEGE
SCHOOL OF AGRICULTURE
AND EXPERIMENT STATION

The Pennsylvania State College

School of Agriculture *and* Experiment Station

Department of Agricultural Education

School Leaflet — No. 2

GARDEN SITES AND SOILS, AND SOIL PREPARATION

By J. S. GARDNER

The Site

Where to put the garden is not always an easy question to answer.

If the grounds are large enough to permit of a choice of location, there are definite rules for guidance. But if the home lot is small, it may be difficult to get a garden into it at all. A strip along a fence may be the only bit of ground available. Even if that is all the ground the gardener can have, and though the soil in it may be unfit, perserverance and a little work will result in a garden of which he may be proud.

The garden site should not be too far from the house, particularly if it is made on a vacant lot borrowed for the purpose. A plot near the gardener's house will save time, for cultivation and weeding can be done at odd moments. Watering will be much easier, too, if the water does not have to be carried far. The pump or hydrant is usually near the house, and it is quite likely that hoes and rakes, too, will be kept conveniently at hand.

The garden should not be made near enough to trees to be shaded for long periods by them. They draw moisture and plant food from the soil, in large quantities; and besides, nearly all garden crops grow better in the open sunshine. The shade of buildings is less injurious than that of trees, but the north side of a building is too

cold for a garden in early spring, and the south and west sides are too hot in midsummer. Any soil that will grow a good crop of grass will produce fair garden crops.

The Soil

Soils are composed mostly of small, rock particles, partly decayed vegetable matter and water. They also contain air, bacteria and plant food. The air and bacteria cause the vegetable matter to decay. The plant food in the vegetable matter and in the rock particles is dissolved by the water so that the plants can make use of it.

Back Yard Garden, Philadelphia Photo from Miss Caro Miller

A good soil is one that contains enough sand or rotted manure to dry it out easily. Manure makes the soil warm and porous and keeps it from baking. In a soil of that kind, the little seed plants do not have much difficulty in pushing up through the ground, and they can be well cared for after they are up.

The garden soil should be one in which the plants will thrive vigorously. If it is cold and sticky and if it remains wet until late in the spring, it will harden and bake after rains into a condition that will interfere with the growing of good crops. But even a cold, clay soil can be improved. The simplest way to make it lighter and warmer is to add sand or coal ashes, and mix them thoroughly with the soil. Or, spade into it rotted lawn clippings, pea vines or tomato stalks; but stable manure would be better than any of these. Weeds should never be used for this purpose, for even if they have had time to rot, their seeds may not be killed.

Another way of getting vegetable matter into the soil is to sow some rye about the first of September, and then spade it under in the spring. For the southern part of the state, crimson clover would be better than rye.

The garden soil must be rich in plant food. Even though some soils may already be fertile, feeding the plants in addition will pay.

Ready for work, Yeagertown, Pa. Photo from H. W. Firth

The best way of doing this is by putting manure on the land. It should be well-rotted, particularly if it is applied in the spring.

Some farmers spread fresh manure on their fields in the fall and plow it under then. This can be done with a garden, too. The manure used in this way will have time to become well rotted by the arrival of spring, when the plants need feeding. Only when the manure is well decayed is the plant food in available condition. A layer two or three inches deep is not too much, though it should be well mixed with the top soil to a depth of five or six inches.

Preparation of the Soil

The best time to spade the garden is in the fall. There are at least six good reasons:

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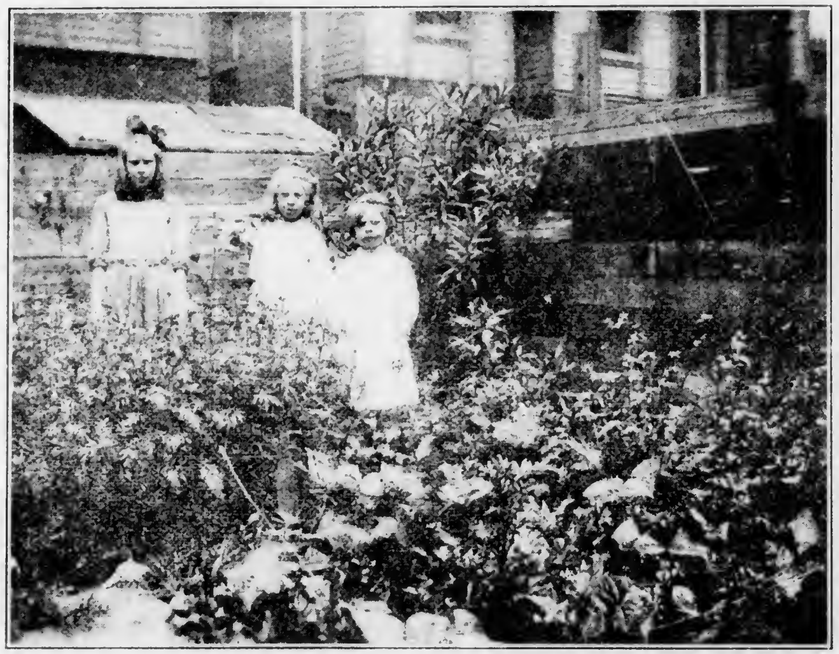

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Preparation of the Soil

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INTENTIONAL SECOND EXPOSURE

1. If the ground is clayey, freezing and thawing through the winter will powder it, and the processes of freezing and thawing can go on better if the ground has been spaded and loosened in the fall.

2. Insects will be killed. Many insects spend the winter burrowed deep in the soil. If the soil is turned up, the chances are that some of these insects will be uncovered or their covering loosened, and the cold will kill them.

3. Certain insects live over winter in the soil, but close to the top. Many of these will be buried so deep in the fall that they will not be able to work out in the spring.

4. If manure is spaded under in the fall it will rot much better by spring than if it is left on the top over winter.

5. The rough surface of a spaded garden will catch and hold winter rains and snows. These will soak in and be kept where the plant roots can get them later on.

6. A garden left rough through the winter will dry off earlier in the spring than one unspaded.

If the garden is spaded in the fall, and the manure turned under then, all that remains to be done in the spring is to rake the soil smooth. If the manure is not spaded under in the fall, it will be necessary to spade some under in the spring. If the ground is heavy, and hard at work, it would be a good thing to put on sand or coal ashes at the same time.

Lime or wood ashes may be put on after the ground is spaded, but should not be spaded in with the manure. Spading should be as deep as the spade will go, unless too much yellow clay is turned up. If too much of this "subsoil", as it is called, is brought up it will make the seedbed tough and sticky, a thing to be guarded against. Then, too, there is very litle plant food in the subsoil.

The next operation is raking. If the garden spot is a new one there may be stones and other things that make it hard for plants to come up and grow well. These should be removed.

If the ground was not dug when too wet, and if it has enough sand or decayed manure in it, there will be few clods. What clods there are should be broken up and the soil made fine. A fine seedbed is needed, and the work required to make it so will pay. In fact, without it, the work put into the garden may be wasted.

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THE PENNSYLVANIA STATE COLLEGE
SCHOOL OF AGRICULTURE
AND EXPERIMENT STATION

The Pennsylvania State College

School of Agriculture and Experiment Station

Department of Agricultural Education

School Leaflet No. 3

SEED SOWING

By J. S. GARDNER

A seed is made up of a wee plantlet, a supply of food for it, and a seed coat on the outside.

The plantlet has two parts: a tiny root and a short stem with leaves. The supply of food in many seeds is found in the cotyledons or "seed leaves" which make up the most of the seed. On this food the plant lives for a little while, until the roots are able to take nourishment from the soil. The seed coat is a dry, woody covering which partly protects the more tender seed parts.

To start the young plant to growing, the seed begins to swell. When it has swelled and swelled, and stretched the seed coat until it will stretch no more, a rent appears in the coat and a white, pointed rootlet comes through.

For a seed to sprout, three things are needed:

1. Moisture in the right amount
2. Warmth
3. Air, or, rather, oxygen

Moisture swells the seed and softens the coat so that the tender rootlet can come through. It dissolves the stored-up plant food so that the young plant can use it. The young plant also uses moisture itself as a food. Moisture stiffens the young plant for its struggle to get to the light.

There is always a certain amount of moisture in all soils. When it is there in quantities large enough to make mud it can be seen

easily. But sometimes there is so little that it can only be told by the darkened color it gives the soil. Such soil may scarcely feel moist and yet have enough moisture to grow some plants well. Even though there is the right amount of moisture in the soil, it may be too cold for sprouting to take place; the water must be warm, just as sugar or salt dissolves quicker in warm than in cold water. If the water is too cold the seed will rot instead of sprouting. Some seeds will sprout in a colder soil than will others. Radishes, cabbage, peas and oats do not need as warm a soil as beans, squash, beets, and corn.

No soil is warm of itself, but some soils are called "warm" or "cold" according to their ability to absorb and hold the heat from the sun. Soil that contains too much moisture, or that is made up of the very finest soil particles, or that is too tightly packed, warms up slowly. In a previous leaflet the importance of raking clods fine was explained; cloddy ground is generally "cold".

A seed needs air for sprouting for the same reason that animals need air. The young plant makes use of the oxygen by combining it with the food which is within the seed. All soils have some air in them. If there is too much moisture or if the ground is packed tight, there will not be enough air left to sprout the seeds or to grow the plants well. A "warm" soil is also a well-aired soil.

Soil is made up of particles of all sizes. Some are so small they cannot be seen without a microscope. From this size they range all the way to cobble stones. The finest particles are called "clay", the next finest "silt", the next "sand", and so on. The more of the fine particles a soil has in it the stickier it is and the more likely it is to break up into clods.

All of these particles have around them a very thin layer of moisture. If the soil particles are small and close together, the spaces between them hold some moisture, too. A very loose soil, gravel for instance, has in it very little moisture, and none that plants can use. A clay soil has particles so fine that it can only be dried out with a great deal of trouble.

If moisture is lost by certain soil particles, they draw more away from some other particles until they have their share again. On warm, sunny days, the top layer of soil is continually drying out by evaporation from the surface, and the soil is kept busy drawing moisture up from below.

When a seed is planted in soil with particles so small that several of them touch it on all sides, what happens? The dry seed coat draws water away from the particles against it and begins to soften. This will go on more rapidly if the soil is open and warm; 90 degrees Fahrenheit is not too warm. Then, the soil particles that have been robbed take moisture from the particles lying against them. But the seed draws that away, too, to dissolve the food inside it, so that the plant can begin to grow. It also takes in air at this time, if it can, so that the little plant can breathe, as well as eat and drink.

If the rootlet of a radish, for instance, is looked at closely, it will be found to be covered with white fuzz. This fuzz, under a microscope, is seen to be a number of white, hair-like strands; they are called "root hairs".

If the soil is well-prepared, these root hairs will burrow among the particles and gather up the moisture and plant food they find there. Other roots are sent out from the stem as branches of the main roots, and the plant makes its home there.

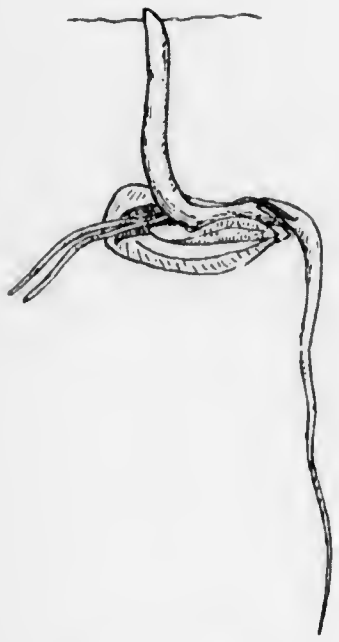
While the roots are reaching down after food, the stem of the plant lengthens and begins to push the first leaves up to the surface of the ground. If the soil particles are too large for the plant to lift, or if they are too tightly packed for it to break through or push between, it may have to give up in despair.

Some vegetables, such as cabbage, beans and tomatoes, push their seed leaves into the light; others, like peas and corn, leave theirs underground. At any rate, a plant has a hard time coming up. To assist it and get best results, certain rules should be followed.

Seed-sowing Rules

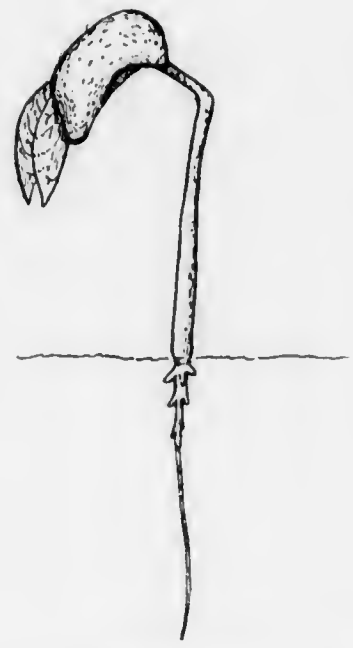
1. Break up the clods in the seedbed; make the soil fine.
2. Rake out all stones and sticks, and other rubbish.
3. Add sand or coal ashes, if the seedbed is heavy and clayey.
4. Work well-rotted manure into the soil, if it is so open that it will not hold water.
5. Do not plant seeds too deep; $\frac{1}{4}$ inch for the small seeds such as lettuce and celery, and 1 inch for the larger seeds such as beans, is the right depth. Corn and peas, since they do not have to push their seed leaves through the ground, may be planted deeper.
6. After the seeds are planted, pack the soil so it will come in contact with them, but leave it loose on top so that they may be able to break the crust.

7. If the seeds are very small and a crust is likely to form, lay a piece of old burlap over the bed until the plants are about ready to come through. This will help to hold the moisture, keep the crust from forming, and prevent the seeds from being washed out in watering.



Sprouting corn

Pea seedling



Seedling bean

Radish seedling, showing root hairs

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Number 4

THE PENNSYLVANIA STATE COLLEGE
SCHOOL OF AGRICULTURE
AND EXPERIMENT STATION

The Pennsylvania State College

School of Agriculture and Experiment Station

Department of Agricultural Education

School Leaflet No. 4

RADISHES, ONIONS, LETTUCE, PEAS

By J. S. GARDNER

These four vegetables are among the first to be started in the spring. They are ready to be harvested in a short time, too. For these reasons they may be put between rows of those vegetables that mature slowly. These late vegetables are planted at the distance apart their tops will need when they are fully grown, but which is practically waste space when they are small. This is called "companion cropping". If crops are so arranged that they follow one another closely, the method is called "succession cropping." Radishes, onions and lettuce, particularly, lend themselves as "companions" to crops that take the whole season to mature, as, for instance, salsify and parsnips. Peas work better in a "succession" scheme.

Radishes

Beside the early spring radishes, there are varieties that take a longer time in which to mature. But the method of growing them all is the same.

Soil: A soil that is to grow good, smooth and straight radishes must have neither sticks nor stones in it. It should be rather sandy and loose so that it will drain well and not bake. It should have enough well-rotted manure in it to hold water; a radish grown in a soil too dry is likely to have a sharp flavor. The manure must be well-rotted, otherwise the radishes may tend to grow to top.

Seed Sowing: Seed for the early round radishes is sown as soon as the ground can be prepared. If the ground is spaded in the fall, seeding time will come just that much earlier.

Seeds are dropped in rows 9 inches apart for the earliest, though 12 inches will be better spacing for the late varieties, if grown alone. The seeds are sown 2 or 3 to the inch and covered with ½ inch of soil.

When they come up the extra plants are pulled out, leaving a radish every inch or inch and a half. This will give them room to reach good edible size. The late radishes seeded in June or July will need as much as 2 or perhaps 3 inches between them.

Later Care: Weeding should certainly be done, if the most rapid growth of the radishes is to take place. Keeping the ground between the rows stirred with a garden rake, if rows are not too close, will save the moisture needed to grow mild radishes.

Varieties—Spring: Scarlet Globe
Summer: Icicle, Strassburg
Winter: White Chinese, Black Spanish

Onions

There are two general ways in which onions are raised: from "sets" and from seed. "Sets" is the term applied to the immature onions which are grown from seed planted very thickly and which remain small for this reason. Some varieties also produce "sets" on their main stalks. Growing onions from "sets" is the more common in a small garden where the early green onions are grown. Onions grown from seed for winter use are not harvested until late in the fall.

Soil: The same kind of soil—fine, and free from rubbish—as that used for radishes is needed to raise good onions. If, however, the soil is inclined to be clayey, the flatter varities can be made to do quite well.

The soil should be rich in plant food. In fact, onions require as much feeding as any of the vegetables. Manure is the best form in which to get this plant food, for manured soil will hold more moisture than one not well supplied with manure.

Setting and Seed Sowing: When grown from "sets" and for green onions, the distance between rows may be somewhat less than when long-season onions are grown from seed. "Sets" are planted right end up, in a trench just deep enough to let the tip peep out after the trench is filled. The spacing for green onions need not be more than 1 inch; for late onions, 3 or 4 inches.

When onions are grown from seed the rows need to be about 15 inches apart to allow for cultivation in the summer and early fall. The seed is sown at the rate of 2 or 3 per inch, and covered about ½ inch deep.

After the seeds have come up well, the extra plants are taken out, the final spacing depending on the use to which the onions are to be put.

Weeding and cultivation should be done through the summer, to save all moisture and plant food possible for the onions.

Green onions from "sets" and late onions grown from the seed make good companions. For this arrangement the seed is planted in rows 18 inches apart, with rows of "sets" half way between. The late onions will not need the full space until some time after the last "set" onions are removed.

Varieties—"Sets": Red, yellow or white.

Seeds (for sandy soils):
- Southport Globe — red, yellow, white
- Danvers Globe — yellow
- White Portugal

Seeds (for heavy soils): Red Wethersfield

Lettuce

Soil: Lettuce needs a soil well enriched with manure both for its plant food and for its moisture-holding ability. The seedbed should furthermore be fine, and have enough sand or decayed vegetable matter for good drainage.

If lettuce is started in a hotbed or a coldframe and transplanted, the matter of soil preparation in the field where lettuce is grown is not quite so important as when seed is sown in the field. If it is seeded in the field where it is to mature an ideal seedbed must be made. All clods should be broken up with a rake or a cultivator so that the small lettuce seeds will have as little trouble as possible in coming up.

Seed Sowing: Seed sowing in the hotbed or coldframe is done as described in the leaflet "How to Make a Hotbed".

When lettuce is grown from seed in the field, it is sown as early as possible in drills 12 inches apart, 8 or 10 seeds per inch, and covered

lightly; ¼ inch is enough if that is possible. The covering should be firmed, so that the soil is sure to touch the seeds. When the plants are well up, they are thinned. This may be done gradually, by simply taking out plants as they crowd; the thinnings may be used for salad. Sometimes, one thinning is made so that there are left standing lettuce plants at intervals of 6 inches. The heads so left will reach good size in from 5 to 8 weeks. When the transplanting method is followed, the plants are taken from the hotbed or the coldframe and set in the field in rows 12 inches apart and 6 inches between them in the row.

Varieties—Head: May King, Big Boston
Loose Leaf: Grand Rapids, Simpson,
Prize Head.

Peas

Soil: Peas need a good garden soil, but it is possible to use too much manure. Unless manure is well-rotted it may cause the peas to grow to leaf. The soil itself may be almost anything from a fine silt to a somewhat gravelly loam. It should be well drained; peas will not do well in wet, soggy ground.

Seed Sowing: Seed is sown as early as the ground can be gotten ready in the spring. If dwarf peas are used the rows may be as close together as 12 inches. A very good way is to sow in pairs of rows 6 inches apart, with 18 inches between the pairs. This saves space and cultivation and the pairs will be self-supporting.

The seed is dropped at the rate of 2 or 3 per inch, or 1 pint to 1 quart per 100 feet of row, according to the size of seed. It is covered from 1 inch to 2 inches deep, the greater depth for lighter or drier soil.

Cultivation and weeding should be begun early and kept up as long as possible.

Peas do not work into many real" companion" schemes of cropping, but a very good "succession" with tomatoes can be made. This is done by simply setting the tomatoes, at the usual setting time, right in the rows of peas. For this scheme, early planting must be done and dwarf varieties of peas used.

Varieties—1. Dwarf: Tom Thumb
Little Marvel
Laxtonian, and
British Wonder
2. Tall: Telephone, and
Edible podded peas.

END OF NUMBER

Number 5

THE PE[illegible]YLVANIA STATE COLLEGE
SCHOOL OF AGRICULTURE
AND EXPERIMENT STATION

The Pennsylvania State College

School of Agriculture and Experiment Station

Department of Agricultural Education

School Leaflet No. 5

TRANSPLANTING

By J. S. GARDNER

Transplanting vegetables is simply moving them from a crowded seedbed to some other soil in which they will have more room to grow. This may be to another part of the hotbed, or to a coldframe, to be described later. Or it may be to a place in the open ground.

There are many reasons for transplanting:

1. It is practiced in growing early vegetables. The early vegetables bring the best prices in the market, hence it pays best to raise them at home. By starting the plants indoors or in a hotbed, and transplanting, the vegetables are ready much earlier than if seed is planted outside.

2. Some vegetables need a longer season for growing than the Pennsylvania climate permits. These must be started inside and transplanted to the garden when the weather becomes warm enough.

3. It is a means of saving space. Seed can be sown thickly—8 or 10 to an inch—and the seedlings transplanted when they need more room. Some plants, as, for instance, tomatoes, improve so much in stockiness from transplanting that moving them twice is a good thing. When the tops begin to crowd in the first transplanting box, it is time to transplant again.

4. Transplanting makes the roots of some crops branch and grow larger. This is a help to the plants after they are set in the open, when they cannot be so well cared for.

Soil for Transplanting

1. The soil of the hotbed or coldframe to which the plants are moved should be fairly rich in plant food; one-quarter of it may be fine, well-rotted manure.

2. It should be open to a certain extent. If it is clayey and tight, sand is added to lighten it up.

3. It should be moist. This does not mean that water should rise when the soil is patted, but there should be more moisture to help the plant revive than is needed at other times.

When transpantings are made from one hotbed to another, or to a coldframe, nothing further is necessary than to have the soil in proper condition. If there is a very bright sun, however, it will be best to shade the newly set plants for the rest of the day.

When transplanting to the outside, the same conditions apply, in a general way, but additional precautions should be taken.

Since the air and soil are cooler outside than in the hotbed, the plants must be prepared for the change. This preparation is known as "hardening off".

"Hardening off" may be done in the hotbed, which will have very little heat after about three weeks, or the plants may be moved to a coldframe.

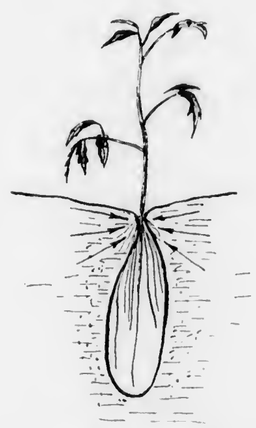
A coldframe is made exactly like a hotbed, except that there is no layer of warm manure under it. It rests on the ground, and is sometimes banked with manure to make it tight, but no heat is used. Sometimes frames covered with muslin or cheesecloth are used instead of hotbed sash for coldframes.

Ventilation is given the same as in a hotbed, but the sash is gradually raised, little by little, and for longer periods, and finally left off altogether.

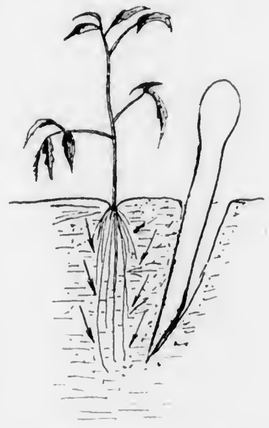
While the plants are being hardened, watering is done very lightly, just enough to keep the plants from wilting. The usual way is to begin "hardening off" about two weeks before setting the plants in the field, but if the seedlings are transplanted once in the hotbed, or to the coldframe, it may begin at that time.

Transplanting Rules

1. Seedlings that are to be transplanted twice should be transplanted first when the rough leaves begin to appear. It is best not to let them get too far past this stage; they become weak and long-stemmed if not moved in time.
2. It is good practice to let the plants dry out for a few days before transplanting. This is particularly true when setting them in the field. They should not wilt down, but no more water should be given than they actually need. They should then be watered heavily from 6 to 12 hours before transplanting.



The wrong way



The right way

3. A cloudy day is best for transplanting. If this is not possible, the later in the afternoon the work is done, the better. This will give the roots the cool night in which to take hold in the soil. Shading newly set plants will help them to get started.
4. A little water in the hole in which plants are to be set is a very good thing. It will then be where the plant needs it. This is much better than pouring water around the plant after it is set.
5. The plant should be set slightly deeper than it was in the seedbed, but care must be taken that the bud or growing part is not covered.

6. After the plant is set, the hole should be filled and the soil pressed tight in such a way that it is against the roots **all the way down.** This is best done by thrusting a dibble, a trowel or a sharp stick into the soil and pressing it toward the plant as shown below. The soil must touch the roots before they can take food and water from it.

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Number 6

THE PENNSYLVANIA STATE COLLEGE
SCHOOL OF AGRICULTURE
AND EXPERIMENT STATION

The Pennsylvania State College

School of Agriculture and Experiment Station

Department of Agricultural Education

School Leaflet No. 6

CABBAGE AND CAULIFLOWER

By J. S. GARDNER

The soil required for growing the best cabbage or cauliflower is one that contains abundant plant food and a large amount of moisture. At the same time it must not be a tight, waterlogged soil; it should be open enough to drain well.

This means that to fit soil for these crops, manure, well-rotted and fine, should be worked into it; 2 or 3 inches of manure is not too much. This will furnish plant food in such condition that the plants can use it, and the soil will take in and hold moisture better because the manure has been added.

Both of these vegetables may be grown as spring or fall crops, although cauliflower is much better as a fall crop.

The Spring Crop

For the growing of early cabbage and cauliflower a hotbed is needed. A bright, sunny window in the kitchen or living room may also be used for starting plants when a hotbed cannot be made. The seeds may be sown in fine, sandy soil in a box about 2 or 3 inches deep. The young plants may be transplanted from the box to a coldframe, or even directly to the garden. The hotbed should be prepared early enough so that the seed can be sown in it between

the 1st and the 15th of March. The plants should be large enough for planting outside the latter part of April, though their size will depend on the manner in which they have been grown.

The seeds are sown ¼ inch deep in drills 3 inches apart, 8 or 10 seeds to the inch. When the first pair of rough leaves appears, the seedlings should be transplanted in the same hotbed in which they were grown or into a coldframe. The plants should be spaced 2 inches apart each way, and the soil in which they are set should be rich garden soil.

Watering will depend on how early it will be possible to set the plants in the open. If they are kept too wet, and kept growing too rapidly, they may crowd each other and become spindly and weak. For this reason it is well to water rather sparingly, so as to make their growth moderate. Plants grown in this way will become sturdy. Their tops will be small and their root systems well developed.

"Watering sparingly" does not mean that water should be put on in small amounts, but that it should not be added too often. When water is applied, it should be given in such a quantity that the ground will be soaked as far down as the roots go. Watering is done whenever the plants begin to lose their stiff and springy appearance; they should not actually wilt before they are watered. It is best to do the watering on sunny days and early in the day so that the plants will dry off before nightfall. Ventilation should be given carefully by raising the sash in the usual manner. As transplanting time approaches the plants should be put through the "hardening off" process, so as to be thoroughly ready when setting out time comes.

Setting in the Field

No exact date can be given; it will depend upon the season and the locality. It is usually considered safe to set cabbage as early as the ground can be prepared. It may be advisable to hold cauliflower for two weeks or more after the earliest possible date, but cabbage, properly hardened off, will be ready by the time ground is in shape.

Setting distances are not always the same. They depend on the varieties grown, on the richness of the soil and on the style of cultivating to be followed, whether hand or horse.

If Jersey Wakefield cabbage is grown, and hand-hoeing is done, the plants may be set as close as 12 inches each way. With this spacing there will be little room left between the plants toward the end of the season.

For Copenhagen Market, a good medium early sort, 15 or 18 inches will be as close as the plants should be crowded. A point against too much crowding is that the ground is early occupied by the plants and their rapid growth makes cultivation difficult, if not altogether impossible.

Setting distances for cauliflower depend on the same conditions as those that govern the spacing of cabbage.

Dwarf Erfurt, a small sort, can be set 12 inches apart each way: for Snowball, 15 to 18 inches each way will not be too much.

The Late Crop

Seed for the fall crop is sown in the open in a well-prepared seedbed about May 25. The seeds are dropped in drills, 8 or 10 seeds to the inch, and covered with ½ to ¾ inch of finely screened soil.

The plants are moved from this seedbed directly to the field about July 1 to 15. Sometimes seed for the late crop is sown in the field where the plants are to grow. The labor of transplanting is saved in this way, but in a small garden, growing plants and transplanting will be more suitable.

Later Care

Cultivation: Cultivation should be given until the plants are so large as to make it impossible. Weeds must be removed, for they use moisture and food needed by the crop. In a dry season this is particularly important, but, even in the best of seasons, keeping the garden clean and the surface soil stirred will pay.

Insects

The insects likely to cause injury are the cutworm, cabbage maggot and cabbage worm.

The cutworm feeds on the roots and stems of many plants, cabbage and cauliflower among them. The injury is done by cutting the plants off at the groundline or slightly below it. The way to protect the plant is to wrap it, when set, with a strip of paper 2 inches

wide, several thicknesses, in such a way that ½ inch or so extends above the ground, the rest below the surface. If the worm cuts off roots below the collar, new ones are formed.

The cabbage maggot also attacks the root just below the ground-line. The way of controlling it is to keep the adult, which is a small fly, from laying eggs near the plant. This is done by placing disks of tar paper made for the purpose around the plant at setting out time.

The cabbage worm is a pale green worm, with brown lines lengthwise; it eats the leaves, riddling them with holes. Stomach poison will kill it. A good form of poison is arsenate of lead one part, and air-slaked lime nine parts, thoroughly mixed, and dusted on the plants in the morning while they are wet with dew.

If it is not considered safe to use arsenate near cutting time, hellebore can be used.

Wood ashes, dusted on the plants, are also used in this way with some success.

What Varieties to Use

The early varieties have been given previously. Good late ones are:

Cabbage: Succession, Danish Ballhead.

Cauliflower: Algiers, Snowball.

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Number 7

PENNSYLVANIA STATE COLLEGE
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EXPERIMENT STATION

The Pennsylvania State College

School of Agriculture and Experiment Station

Department of Agricultural Education

School Leaflet No. 7

GREENS

By J. S. GARDNER

The greens are leaf crops which are cooked to prepare them for food. Among them are some of the earliest vegetables. Others withstand dry, hot summers in edible condition, and the last of them do not freeze until snowfall.

Soil. All greens need moisture and plant food in large quantities. The soil should accordingly be well supplied with well-rotted manure, both for the food it contains and for the power it gives to the soil to hold water.

Spinach

Spinach is a short-season green that can be grown in the cool weather of either spring or fall.

The Spring Crop. This crop is usually planted in rows, though sometimes it is sown broadcast. In either case spinach seed is sown as early as the ground can be prepared in the spring. Sometimes the soil is prepared in the fall, and after the middle of February the seed is sown on the frozen ground and covered with an inch or two of fine well-rotted manure. This will produce very early spinach.

Another way is to drop the seed in the drills 10 to 14 inches apart, 3 seeds per inch, and cover them with ½ inch of fine, well-manured soil. Started early; in this way, there should be spinach lasting as long as it is palatable. It goes to seed quickly when the warm weather begins.

The Fall Crop. This crop is almost always sown broadcast. It is used as a "succession" crop to sweet corn, early potatoes, or medium early cabbage. For this purpose the seed is broadcast as the spinach is needed, on ground which has received no other preparation than a raking and smoothing of the surface. The cool weather in early autumn will make it grow vigorously, and spinach can be cut until severe frost occurs.

Varieties: Victoria (Round-leaved)
Long Season (Thick-leaved)

Mustard

Mustard is grown by exactly the same methods as those described for raising spinach. It is regarded rather as a spring green only; in that respect it differs from spinach, which is a spring and a fall crop.

When cutting time is over, care should be taken to remove or destroy the plants not used. Once mustard is allowed to go to seed, it develops into a very troublesome weed.

Varieties: White London
Elephant's Ear.

Both spinach and mustard make excellent "companions" for any of the long-season crops, such as parsnip, salsify and carrot, or, they may be put in rows alternating with the summer greens, which are described next.

Chard or Swiss Chard

Chard is a member of the beet family, grown for its tops. The roots are not large and fleshy enough for food. It is one of the summer greens, and requires a longer time than spinach to grow. For this reason it can be intercropped with spinach or mustard.

The seed is sown rather early in the spring, about two weeks after the very early crops are in the ground. It is sown in drills 15 to 18 inches apart, 2 seeds per inch, and covered ½ inch deep. This is much too close together for the plants to stand finally in the row; hence they are thinned. Thinning to the final stand may be done at one time, or it may be done gradually. The thinnings make delicious, tender greens. The plants should finally stand 6 inches apart in the row.

Greens—Chard and New Zealand Spinach

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Greens—Chard and New Zealand Spinach

INTENTIONAL SECOND EXPOSURE

When the early greens are gone, harvesting the chard may begin. This is done by pulling the outer leaves. It must be done carefully, by pulling downward, in order not to disturb the roots or the growing centers of the plant. New leaves will be formed all through the summer, and until severe frost occurs.

Chard has no especially injurious pest, though when the asters begin to bloom the blister beetles sometimes attack the chard, too. Handpicking, early in the morning, while it is still cool, is about the best method of control. Poisoning the beetles by spraying would make the chard unsafe for food.

The best variety of chard is Lucullus.

New Zealand Spinach

This is another of the summer greens, a stranger to many gardens, but its acquaintance is worth while.

New Zealand Spinach is a rather spreading grower, but since it grows slowly it can be intercropped with early greens or other short-season vegetables, in the early part of the summer.

New Zealand Spinach seed is sown in rows 3 to 4 feet apart, the seeds being dropped every 6 inches. When the plants are well up, they are thinned so as to stand from 18 to 24 inches apart.

The plants should be allowed to grow to good size before cutting begins. The succulent growing tips are removed after a few leaves have formed. The greens are found to be excellent, and the amount supplied quite satisfactory. The plants frost-kill, though they are somewhat hardier than tomatoes. Only a few plants are necessary to supply a large family.

The blister beetle also attacks this crop. Control of the beetle is described under "Chard".

There is only one variety: New Zealand Spinach.

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Number 8

PENNSYLVANIA STATE
SCHOOL OF AGRICULTURE
AND EXPERIMENT STATION

The Pennsylvania State College

School of Agriculture and Experiment Station

Department of Agricultural Education

School Leaflet No. 8

BEETS, CARROTS, TURNIPS, PARSNIPS AND SALSIFY

By J. S. GARDNER

The first three of these root vegetables are ready to use 2 to 3½ months after planting. Parsnips and salsify, however, must have the whole season to grow. They are well suited to be "companion crops" to radishes, green onions, lettuce, or the "greens", but not to each other.

Soil

The soil for these crops must be reasonably free from stones or sticks or anything else that might prove to be an obstruction and keep them from growing smooth, clean roots. There should be a good supply of moisture, and furthermore, the soil and sub-soil should be loose enough for thorough drainage. A soil containing a quantity of well-decayed vegetable matter will have these requirements. Manure for root crops must be well-rotted, and not fresh from the stable.

Beets

Beets may be either a short-season crop, in which they are grown for "greens" or for small beets, or they may be grown for winter storage.

Early beets are seeded in the spring, 10 days or two weeks after the very earliest crops are put in. The seed is sown in drills or rows, 12 to 15 inches apart, two or three seeds per inch, and covered with ½ inch of soil.

When the plants are well up, thinning is done, so that they will stand an inch apart in the row. The thinnings make good greens. When the beets begin to crowd they are thinned again, until they finally stand 3 or 4 inches apart. The beets left standing will grow until fall, when they are put away for use during the winter.

Beets have no pests that deserve mention.

Varieties—Early: Crosby's Egyptian
Late: Detroit Dark Red.

Carrots

Carrots belong to the second early crops, and are generally planted between June 15 and July 1.

The seeds are quite small and frequently many of them are broken. For this reason seeding is done quite closely, 8 or 10 to the inch in rows 12 to 18 inches apart. The soil should be in ideal shape and the covering of the seed as light as possible and well firmed over them.

Since carrots come up very slowly a few radish seeds are sown with them as "markers" for the rows. As soon as the radishes are up, cultivation can begin.

It is quite likely that with the thick planting advised, the plants will stand too close together. Thinning should be done so as to leave them at least 1 inch apart; later they are thinned to 3 inches. Those removed are used for food.

Since this is an all-summer crop, cultivating should be kept up until fall.

After the first light frosts, carrots should be dug. They will not stand heavy freezing.

Varieties—Very Early: French Forcing
Medium: Chantenay
Danver's Half Long

Turnips

Turnips are a short-season crop, but are included in this group because they are stored over winter like the others in the list.

As a spring crop, they are sown at the same time that beets are sown, generally in rows. The seeds are dropped in exactly the way

In the back-yard garden

Early Beets

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In the back-yard garden

Early Beets

INTENTIONAL SECOND EXPOSURE

described under radishes, and the plants thinned first to 1½ inches and later to 3 inches or thereabouts. When warm weather comes the last of them should be pulled. The ground can then be used for a planting of bush beans or other summer sown crop.

The late crop is seeded about August 1, broadcast or in rows. They may follow peas, early beans, or early potatoes with very little soil preparation. Another plan is to sow them among the cut off stalks of an early sweet corn planting. A method followed in some gardens is broadcasting thinly between rows of late potatoes, at the last cultivation. The turnips mature after the potatoes are dug.

When grown in a cool season, spring or fall, very few insects trouble turnips to a serious degree. If there is much hot, dry weather, plant lice may become troublesome. Tobacco solution sprayed on the tops will check this pest.

Varieties: Extra Early Purple Top
White Milan Petrowski.

Parsnips and Salsify

These two long-season root vegetables may easily be discussed together. They do not resemble each other in appearance, but their season, soil requirements and uses are the same.

Seed is sown rather thickly in drills 12 to 18 inches apart, and covered with ½ inch to 1 inch of soil. The seedlings of parsnips come up very slowly, making the use of radish" markers" as recommended for carrots a good thing.

When seedlings have come up in good condition, they are thinned so that the plants stand from 4 to 5 inches apart for parsnips and about 3 inches for salsify.

Cultivation is given all summer.

Harvesting may be done at any time in the fall, preferably after frost. These vegetables are perfectly hardy and are actually improved in quality by freezing. Part of the crop is dug before the ground freezes, and stored in barrels or boxes of soil, in cool cellars. The rest of the crop is left standing in the rows in which it grew, to be dug in the early spring as soon as the ground thaws out.

Varieties—Parsnips: Hollow Crown
Salsify: Sandwich Island.

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Number 9

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The Pennsylvania State College

School of Agriculture and Experiment Station

Department of Agricultural Education

School Leaflet No. 9

TOMATOES, PEPPERS, EGGPLANTS

These three vegetables are all warm weather crops. Tomatoes are rather hardier than the other two, but even they will not survive any but the mildest frosts.

Tomatoes

For early tomatoes a hotbed is necessary. If it is not possible to use a special forcing structure, a sunny window in the kitchen or living room may be used. Unless the plants get abundant sunshine they may become spindly and weak. Six or eight weeks before it is safe to set the plants in the garden the seed should be sown in a box filled with a well-prepared soil. The soil should have enough sand to prevent baking, as that would interfere with the coming up of the tender seedlings. The sand would also take care of extra moisture.

As the seeds sprout slowly it may be as much as two weeks before all come up. When the first rough leaves appear it is time to transplant the seedlings into other boxes or another hotbed. The soil of the new bed should have some fine well-rotted manure worked into it. One-quarter manure is not too much.

The plants should be spaced at least 3 inches apart each way, unless another transplanting is made before they are set in the field. Although a second transplanting is not absolutely necessary, it will pay. The setting distances in that case would be: in the first trans-

planting, 2 inches apart each way; in the second, 3 or 4 inches each way.

It is important that watering be done carefully, so that the plants will not grow tall and sappy. Diseases are inclined to attack plants grown with too much water. By growing them slowly it will be easier to hold them if spring happens to be late.

Setting in the garden is done when danger of frost is over. It is possible to protect the plants from mild frosts by means of tents made of newspapers, but it is best not to take too many chances.

If the tomatoes are to be trained to stakes and pruned they may be set in rows 30 to 36 inches apart, 18 inches apart in the row.

The stakes should be stout and no less than 4 feet tall when driven; 5 feet is better. The vines are tied below the clusters of fruit, with two turns around the stake and one loose one around the stalk. Coarse twine or strips of cloth or raffia may be used. The tying material should be strong enough to do the work.

If the plants are allowed to spread over the ground unpruned, 48 inches each way will give them room enough, except perhaps in a very wet season when top growth is rank.

Pruning consists in the removal of the shoots that arise just above the bases of the leaves. If this is done when the shoots first appear, they can be pinchedout; if they are allowed to grow to some size, cutting is necessary. Care should always be taken to make the cut away from the main stem; an inexperienced pruner may accidentally cut the plant off unless this precaution is taken. The earlier the pruning, the less energy the plant will waste in growing side shoots, and the better will be the fruit on the main stem.

Some gardeners who desire particularly early and fine fruit cut off the growing tip of the plant just beyond, let us say, the fifth cluster. The tomato vine will bear only five clusters in this way, but the fruit will get the full strength of the plant, will be of very good size and will ripen earlier than if the plant were still producing more blossoms and fruit higher up.

Insects

Very few insects trouble tomatoes to an injurious extent, but there is one that needs attention sometimes.

The tomato worm—a large, green, smooth caterpillar—frequently chews the leaves of the tomato and makes considerable headway before its work is observed. The simplest way of controlling the pest is to hunt it down and destroy it. It does not appear in too great numbers for this method of control, but, once its work is observed, search should be made; one worm can do serious damage if left to itself for any length of time.

Peppers and Eggplants

These two crops can be described together, since they are very much alike in many ways. They resemble tomatoes so much in manner of growing that except for the points mentioned later, the same rules that govern the growing of tomatoes will apply to eggplants and peppers.

They may be transplanted once or twice. If but one transplanting is made it will be best to space eggplants 4 inches apart each way; peppers will have enough room if the spacing is 3 inches.

These vegetables require particular care in transplanting. Rough handling of the roots may not show immediately, but the amount of fruit certainly will be reduced by carelessness.

These vegetables will not, while in the transplanting box, submit to any check in the way of watering or feeding. The soil should have a good supply of plant food and enough water to keep the plants growing sturdily.

Setting in the garden must not be done until all danger of frost is over. A check from even a mild frost affects the crop in much the same way as does any other kind of check.

Setting distances for peppers depend somewhat on varieties, though a good general rule is to place them no closer than 18 inches in the row, and the rows far enough apart to permit of cultivation and picking; 30 inches will not be too close. Eggplants are set far enough apart to prevent crowding. In some seasons more top growth will take place than in others, but an average spacing of from 30 inches to 3 feet in the row, with enough width between rows to allow passage, will be found satisfactory. Neither peppers nor eggplants are staked or pruned.

Peppers are not much injured by insect attacks, but eggplants sometimes are.

In dry, hot weather, particularly, a minute, jumping beetle is found to infest eggplants; it riddles the leaves with holes about the size of a pin head. Control is difficult, but if the plants are dusted

in the early part of the day, before the dew dries off, with a mixture of 9 parts of air-slaked lime and 1 part of arsenate of lead powder, the damage can be somewhat reduced. A convenient way of applying this dust is to make a large "shaker" of a quart jar or baking powder can by punching the top full of holes. Another is to put the dust in bags of cheesecloth and shake them over the plants.

Varieties—

Tomatoes:

Chalk's Jewel (early)
Matchless (late)

Peppers:

Ruby King (generally sweet)
Neapolitan (generally sweet)
Cayenne (hot)

Eggplants:

Black Beauty
Ivory (white; a novelty).

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The Pennsylvania State College

School of Agriculture and Experiment Station

Department of Agricultural Education

School Leaflet No. 10

SWEET CORN AND BEANS

By J. S. GARDNER

These crops are started at almost the same time; both are "warm" crops, that is, they are not able to stand much frost. They resemble each other in the respect that repeated plantings may be made to keep fresh supplies coming on, but they differ in many other ways.

Sweet Corn

Soil. Soil for sweet corn must be rich in plant food. It must be capable of holding moisture well, for the corn plant must have water in large amounts.

The soil must be well-aired and well-drained, for corn needs a "warm" soil. For the early crops, a southern slope is good. The best single way of getting land into good shape for corn is to work well-rotted manure into it. As much as 2 or 3 inches can be used with good effect.

Planting. The time for planting corn depends on the locality and season. Corn will not live through severe frosts at all, and sometimes light frosts kill it. But the seed, when protected by a covering of earth, will stand quite cold weather if sprouting has not gone too far.

The safe seeding time is after all danger of frost is over. But since the cost of seed and the trouble of planting are quite small, it may pay to take a chance, and plant the corn, even though there is danger of losing it through frost. If the corn should escape, it will be ready so much the sooner. Corn even 2 or 3 inches high may sometimes be frozen down to the ground and yet recover.

There are two main ways of planting the seed: in hills and in drills. Which one to use depends on the desire of the gardener. If drills are used, they are made 30 to 42 inches apart, depending upon the variety, and the kernels are dropped every 4 to 6 inches. They are covered with about 2 inches of soil, and the soil is firmed. It is best to thin the plants soon after they come up to 9 inches apart in the row for the small varieties and 12 inches for the large ones. If the corn is planted in hills, they are spaced 3 to 3½ feet apart each way, with from 3 to 4 plants in the hill. This means that about 6 seeds should be planted to the hill and the poorer stalks removed.

Later Care. If the drill method of planting is used, cultivation of the ground can be done in only one direction. When the corn is planted in hills, cultivation in both directions can be given.

Cultivation will remove weeds and keep the top soil well broken up. This will insure a supply of moisture, for it will keep soil water from passing into the air to some extent, and the open structure will absorb the rain water as it falls. Corn has a shallow root system; therefore, cultivating or hoeing must not be too deep nor too close to the plant. Cutting off the roots of the corn plant deprives it of the means of obtaining moisture and plant food.

Varieties. There are many varieties which differ in some measure in the time required to make good ears. An "early" variety is one that matures early. Among the earliest are Peep O'Day and White Cob Cory. Early Adams is earlier and hardier than either of these, but it is not a sweet corn. Next come Golden Bantam and Howling Mob. The late, long-season varieties are Country Gentleman and Stowell's Evergreen. Plantings of these varieties will provide a succession of fresh roasting ears, or, if plantings of the earlier sorts are made every two weeks until well into July, fresh corn will be available until fall frosts kill the stalks. Early Adams, Peep O'Day and Golden Bantam are small growing varieties, and may be planted closer than the others.

Beans

There are two classes of garden beans: bush and pole. Of each of these there are the so-called "snap" beans and the lima beans, sometimes called "butter" beans. All are more sensitive to frost than sweet corn is; the limas are particularly sensitive.

Soil. The soil for beans should have a large amount of vegetable matter, so that water will be held within it. The amount of plant food may be smaller than that needed for the best crops of corn. To insure a good crop, well-rotted manure should be worked into the soil, for the beans do not thrive on soil that is too poor.

Planting. The exact time for planting beans will depend on the locality. Snap beans will survive light frosts, hence it may be worth while to make an early planting before it is certain that frosts are over. Lima beans are very much more tender; nothing is gained by planting them before all danger of frost is removed. Plantings of snap beans can be made every two weeks until July 15. This will provide fresh beans until fall.

The planting distances will vary with the sort of bean used. If bush limas or bush snap beans are grown, the seeds are dropped every 2 to 4 inches, in rows 16 to 18 inches apart.

The pole varieties of both snap and lima beans are planted in hills 3 to 4 feet apart each way. There may be from 3 to 6 plants in a hill. Some growers place each lima bean on edge with the eye down. It is claimed they get through the ground better. Sometimes pole beans are planted in rows and the vines are supported on chicken wire or on a trellis made of cord, or binder twine. These rows will need to be spaced from 30 to 36 inches apart. The seeds are dropped as in the case of the bush beans. If poles are used they would better be set before the beans are planted. Some varieties do well planted with corn, one seed beside each hill of corn, after the corn is well up. A tall growing variety of corn should be used, and not planted too thick.

Later Care. Cultivation must be regular in order to break up the soil crust, and to keep it finely broken. If this is done, the rain that falls even in short showers will do the beans good. Cultivation will also keep down weeds that would take food and moisture from the crop; some hand weeding may be necessary. The best time to cultivate or weed is about noon or slightly later. At this hour the vines

are somewhat wilted, and they do not snap off so easily as they might earlier in the day. Beans must not be hoed nor the vines handled early in the morning when wet. It tends to spread rust.

Varieties—Bush snap beans:

Wax or yellow podded: Brittle Wax, Pencil-pod Black

Green podded: Stringless Green Pod, Fordhook Favorite.

Pole snap beans:

Wax or yellow podded: Golden Cluster

Green podded: Kentucky Wonder

Bush Lima beans: Fordhook Bush and Henderson's Bush.

Pole Lima beans: Early Leviathan, King of the Garden.

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